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1 Introduction

Carbon matters. And it is computed. In a culture. Underlying calculations are configured; and they could be configured otherwise. To open a space for conceptual discussion about carbon, this article attempts to reconstruct the extended and distributed practices of knowing carbon emissions with the help of scholarship from the field of Science and Technology Studies (STS) on heterogeneity and qualculation. To that end, the following pages serve to characterise the machinic quality of a specific technology, one which is often construed as a means for reconciling capitalism with "Nature": the corporate social construction and accounting of carbon dioxide emissions.[1] This allows us to problematise and contextualise the distributed and heterogeneous intelligence assembled by human and non-humans to make intelligible their corporation's carbon footprint. Politically, engagement with this kind of intelligence is key to a critical understanding of the limits to managing the environment.[2]
By engaging empirically with carbon accounting, this article offers a contribution to the analysis of the hegemonic to dealing with environmental issues (ecological modernisation) and illustrates the generative quality of conceptual work on heterogeneous assemblages. These two fields require brief introductions.

Computing Emissions as Ecological Modernisation

Recent research on carbon emission information in corporate practice[3] treats the information itself as a 'black box'.[4] It is deemed self-evident that carbon emission information is readily available for managers to use. In this kind of literature, the role of accountants is merely to accumulate the information and present it for the purposes of sustainability management and Corporate Social Responsibility (CSR). The information itself is assumed to exist in quantitative form: carbon footprints themselves are the unproblematic products of accountants' practices.

Discursively, this approach can be understood as highly interwoven with the hegemonic discourses of sustainable development,[5] suggesting that corporations are prime actors in rendering economies and societies green, an approach that is called ecological modernisation.[6] This latter concept refers to a rationality-ideology which would supposedly reconcile capitalism with "nature".[7] The primary means by which this is assumed to take place are technologies, both social and material. Carbon accounting is considered a key technology to provide for rational emission management, serving to tackle climate change. By employing a so-called Environmental Management System (EMS), the discourse of ecological modernisation suggests, corporations would be able to translate emission information into plans for greening activities, which would be subsequently evaluated, externally audited and, in a circular movement, continuously improved.[8]
This article addresses the fundamental element assumed to be readily available in these outlines of greening corporate conduct: knowing carbon emissions. To do this, below, I introduce the shared and distributed system of cognition used by those actors who run the corporation's EMS – and as part of this – its carbon accounting.

(Re)conceptualising a Technology of Carbon Cognition

Corporate carbon accounting is usually carried out by employing some form of database. Database technology is taken for granted almost as much as the very idea that carbon information is simply available to accountants. However, the field of STS warns against considering technology as a simple, clearly bounded and unproblematic entity. Similarly, engaging with Guattari's thought, we find him claiming:

We need to free ourselves from a solitary reference to technological machines and expand the concept of machine so as to situate the machine's adjacence to incorporeal Universes of reference.[9]

Guattari suggests that machines are not merely technological but are also related to incorporeal e.g. semiotic fields. This article investigates how we might conceptualise carbon accounting as a machine which is not merely a straightforward technological enterprise but is closely interwoven with fields of discursive references. In his work he also proposes that

[w]e cannot conceive of solutions to the poisoning of the atmosphere and to global warming due to the greenhouse effect [...] without a mutation of mentality, without promoting a new art of living in society.[10]

While there is not space in this article to develop a fully fledged alternative political and ecological philosophy, I am able to contribute a reconceptualisation of the every-day corporate practices of knowing carbon emissions – mentally and technologically. This, I hope, supports the grounding of any kind of vision and practice of putting emancipatory relations into practice.

Within STS, engaging with climate change and carbon in not new. According to Szerszynski and Urry[11] descriptions of climate change entail normative prescriptions about society. Following Asdal,[12] political arguments involving "Nature" are not by themselves depoliticised. Rather, the question of what kind of politics is black-boxed into Nature – and, I would like to add, into "Carbon" is an empirical one. STS exhibits a tradition of engaging with questions of climate change.[13] Recent work by STS scholars and other social scientists on the rapidly developing economic instrument of carbon markets[14] implies that there is a need for empirical studies of carbon accounting[15]

This article does not in any way claim to have unmediated access to carbon dioxide or any other greenhouse gases (GHG). While I assume GHG to be real, [16] I understand societal and economic engagement with carbon as something that is performed by humans in interaction with various devices. In corporations, for example, specific agents are ordered to figure out a corporation's carbon emissions. Thus, these agents, through their practical work, socially and materially construct emissions as a social, cultural, political and economic reality. If a corporate environmental manager submits to publics a corporation's carbon footprint, s/he is not submitting emissions but statements claiming to factually capture the essence of these emissions; such facts are akin to Latour's scientific facts in that they are statements which claim to be traceable back to their sources (whether they are, is another question).[17] Adopting this point of view will move us into the practical reality of accountants who communicate, jot notes, carefully document, delete, translate data; these agents can be considered heterogeneous engineers.[18] Their work consists of configuring humans and non-humans, tangible and incorporeal elements. And these elements may need to be continuously maintained in order to prevent them from falling apart in the face of various other forces meeting them. Mol,[19] therefore, uses the notion enactment, rather than social construction, to understand the work of practitioners. Agents are not simply socially constructing a construal about carbon emissions once and forever; much rather, in order for such a fact to go on existing, the accountants employ all kinds of resources to keep the fact in shape. In this understanding,[20] as in Guattari's, a machine may turn out to be heterogeneous; its materially, socially, or otherwise mediated

configurations and stabilisation is an empirical question. Along these lines, we discuss how corporate agents are part of a machinic assemblage that configures the quality and scope of corporate carbon computation.

Studying Carbon Emissions

This article is grounded in an ethnography scrutinising practices of agents of ecological modernisation.[21] I describe, understand and (re)conceptualise the living, breathing, human actors who are supposed to ecologically modernise their environments and their practices, i.e., their culture. To study this culture, one needs to look at the hegemonic form of corporate practices. Thus, I have not chosen some niche green company, but rather a multinational player. In line with Strathern[22] I follow partial connections within the field – rather than exercising what Haraway[23] calls a god-trick.

The account developed in this story is based on fieldwork in the heart of one of the world largest corporate groups in the financial services sector.[24] I shall call this corporate group Global Finance Quality (GFQ).[25] To substantiate the position of the corporation vis-à-vis other companies, I provide two numbers: GFQ employed more than 10,000 workers and during my field work[26] its profits amounted to over 7,000 million USD. My prime field site was the head quarters (HQ) based CSR unit, and specifically the offices of the team employed to perform GFQ's EMS including carbon accounting.

From the point of view of the corporation, my primary task was to help them out with a database that members used to collect environmental data. As a trained environmental manager with IT skills and knowledge, I tested the software, co-ordinated its updating and configured it according to the wishes of its users. Acting as a low-paid white-collar worker, I interfaced between corporate environmental managers and the IT company, which developed and maintained the database. When my boss was introducing me to other corporate actors, she would first of all explain this technical task, and then say that I was also doing doctoral research on cultural aspects of environmental management.

The corporation had committed itself to the discourses of sustainable development and ecological modernisation, promising its stakeholders the integration of environmental considerations into business practices.

Furthermore, the corporation had publicly announced the voluntary reduction of its carbon emissions by 25% between 2006 and 2015. Vis-à-vis the board of directors, GFQ's agents of ecological modernisation stressed that measuring and decreasing the corporation's carbon footprint was relevant to being considered a green business by powerful ratings agencies. This was the financial motivation to engage with greening GFQ: showing up as highly ranked in indicators, such as the Dow Jones Sustainability Index promised attracting so-called socially responsible investment. In the latter the bourgeois (Western?) middle classes are very interested; many, including myself and maybe the readers, try to make certain that their savings are doing good in the hands of their "chosen" financial service provider.

Organisation of the Article

Drawing primarily on the debate about extended cognition and using the sensibilities provided by ANT, I analyse instances of corporate carbon accounting practices to illustrate the distributed and heterogeneous elements assembled in its course to render carbon emissions intelligible. In order to address the wider societal implications of this socio-technical network I elaborate on administration practices with the thought of Guattari.[27] Employing his notion of the machine, I argue, allows us to sense the diagrammatic character of the ubiquitous references to carbon emissions. Thus, this paper offers analyses of the administrative and computational culture of corporate agents of ecological modernisation collectively achieving the establishment of their organisation's carbon emission facts.[28]

The following sections of this paper introduce and discuss instances of agents' practices

encountered during my field work. I first conceptualise the practices of members and references to these practices in terms of the implied capacity for cognition, resulting in a discussion of corporate carbon accounting as an extended system of cognition. Second, I investigate several breakdowns of this system and through that conceptualise its scope and limits as a machinery. The paper concludes by contextualising the function of the machinery in wider society and the ubiquitous references to carbon.

2 Carbon Accounting as an Extended System of Cognition

In this section, I reconstruct carbon cognition as a system spread over several humans and extended to their collectively used accounting database. To set out, I turn to a meeting of the EMS-Team. This team was organisationally located at the CSR unit of GFQ. It consisted of several members, heterarchically configured: a head of environmental and carbon strategy, my boss, Victoria Miller, and the corporate environmental manager, Frederik Steine, were positioned at the same level in the hierarchy. Both had assistants – I was assigned to Victoria during my field work.
The EMS-Team had asked local environmental managers from subsidiaries to submit information about the consumption of a variety of goods and services earlier that year. Each local agent of such a subsidiary, abbreviated in the following as GFQ Corporate (Group) Entity (GCE), had been asked to collect data on five so-called key performance indicators: how much water, energy and paper had been consumed at a GCE, how far they had travelled, how much waste they had produced. Local agents had then collected the data and submitted it by means of a centralised database, designated Environmental and Social Data Reporting (ESDR). Each year, the HQ agents would ask local agents to submit such data and later on HQ based Frederik and his assistant Elise Richards would analyse the data and produce so-called environmental balance sheets for each GCE as well as for the total corporate group, GFQ.
During a meeting in which the status and implications of data delivered by GCEs had been discussed, Frederik reported on deviations in the numbers reported between the current and the recent reporting period. He commented:

Field Note Extract 2.a (Comparing to Base Line)
The US GCEs seemingly did not really recognise that 2006 is the base year. That is to say, GCEs were allowed to mend the numbers for 2006 and 2007. The US GCEs apparently corrected the ones for 2007, such that in comparing 2007/2008 they look fine, but not when comparing 2006/2008. Frederik: "The question is, which numbers to enter."

Frederik's emphasis that someone had a choice over what numbers to enter, renders visible that GFQ's carbon accounting was not standardised in a way which would determine what numbers would have been entered. Towards the end of this article we shall understand that no configuration of carbon accounting would ever achieve a determined system of accounting. At least a situationally contingent form of choice is always present. In this case, this choice was strategically relevant: a GCE was able to make itself look good in terms of the relative carbon reduction targets by altering the data representing the past. Thus, say, if a GCE increased numbers representing past carbon emissions (e.g. 2007: from 3t to 3.2t per employee) while not altering current numbers (2.8t), the reduction of carbon emissions would increase as well (from 200kg reduced to 400kg reduced; i.e. from about 6.6% reduction to about 12.2% reduction).
The recognition that data was not simply available "out there" but required agents who took decisions over which numbers to enter reconfigures our understanding of numbers. Agents needed to navigate between numbers, organise, select, detach and translate them into another space. In such a process the numbers are manipulated and transformed. In my research on GCE's agents I found them summing up numbers and creatively engaged with the problems of classification on the ground.10 Implicit in Frederik's statement is that the US agents had made the wrong choices, or judgements, in forming the numbers they reported to the HQ. Callon and Law[29] discuss the quality of calculations and argue that

calculations normally imply the enactment of qualitative judgements. They use the concept qualculation as an indicator of a calculative and judgement-entailing engagement. This notion carries the meaning of quality as combined with numerical operations. Verran's work on numbers[30] provides texture to the thesis that generally numbers are outcomes of particular situations in which humans act. Under different conditions, alternative constructions of numbers take place. At GFQ, the routines of data construction have not been stabilised enough to prevent numbers from being recognised. Normally, Verran claims, stabilisation is unseen.[31] The idea of (non)recognition by others raises the question of why Frederik rendered these numbers present in the meeting.

Unpacking this moment further leads us into discussing distributed thought and cognition. The US GCEs had submitted data for the years 2006, 2007 and 2008. In this meeting with his colleagues, Frederik pointed to the fact that the numbers did not fit his expectations. In this corporate context, if a situation was perceived as normal and acceptably adequate, members would not draw attention to "the normal". Only when the situation presented itself in a way that was not welcomed by EMS-Team members, they would point out problems. In this case, Frederik pointed to a situation that he had recognised as strange. How did he come to this cognition? He had compared numbers that he had retrieved from their database, ESDR. He used these numbers as mirroring the quantities reported from the local GCEs. Like Clark's[32] Inga 2-step argument, we find Frederik using the information retrieved from the database "transparently, as it were". Where did these numbers and quantities come from? Local environmental managers put them into the database – but they were supposed to put them into the database according to specific criteria, i.e. judgements: partially these criteria were inscribed into the database itself – ESDR contained definitions about each category such as for, e.g., car travel data; they were also made verbally explicit during training for the local agents and in PowerPoint slides produced for these training sessions. Local agents were expected to think according to these criteria, and in the spirit of a GFQ approach, to implement these criteria. As we are dealing with a corporate setup and contractual work relations these expectations can be considered orders. The order by the EMS-Team was that local environmental managers should submit numbers that fit in. Thus, the recognition that numbers did not fit, should have taken place at the local site – such numbers should have not been reported or they should have been altered such that they would fit. Hence, I argue, we can conceptualise these humans and the database as enacting a shared cognitive process of qualculation. Note, the parity principle is met here for the connection between Frederik, the database and the local managers: the database and its information is readily available and information retrieved from it is automatically endorsed as representing the corporate reality. The point is that the corporate reality is what the numbers say, not what the numbers represent. In the firm, real carbon emissions do not matter as much as their actual construal in the database. The situation shown above was dealing with the construal, rather than with the reality. For Frederik's extended system of cognition the question was, "which numbers to enter", rather than how much carbon had been actually emitted. For him it was important that the corporation's carbon memory was operative and trustable. Compare this to the 2010 film *Inception* with the subheading *your mind is the scene of the crime*: even though your mind can be altered it is the only mind you have to perceive the world. Or, alternatively, imagine you are talking on the phone: you would also truly believe that what you hear on the phone is what the other person says. What you think of the content is another question. You use the phone as an extension of yourself to perceive the world. However, the other person at the other side of the line is not anymore part of your extended system of cognition. Yet, you may note that something is wrong with either of the phones or the line. This does not imply that the phone system ceases to be part of your extended system of cognition. Rather, you try to get it working again.

The administration and computation of carbon emissions differs in a significant way from the phone example. Contrary to the standardisation of phones and landlines, carbon calculations are not yet that coherently standardised. While the IPCC repeatedly provided "better" global warming potential factors, within GFQ several competing standards

supplying carbon conversion factors were in use. The field note extract above underlines that the administration of carbon employed by GFQ was intended to maintain GFQ's carbon memory. This needed careful attention by the HQ agents. For, what a working carbon memory was, was not determined by any external standard but had to be locally figured out.
Nevertheless, with respect to the reality of carbon emissions and environmentally relevant consumption, or the person on the other side of the phone, we may also note that members of the EMS-Team used "reality" as an argument to declare numbers as non-fitting. In another meeting, members reviewed the general status of the corporate carbon memory:

Field Note Extract 2.b (Plausible Data)
suddenly Frederik asked Victoria: Mrs Miller, what do you pay for a kilowatt hour Victoria: 18-19 cent/kWh. Frederik: correct. And Belgium pays 140 EUR/kilowatt-hour for biogas electricity. "The comma simply got off the mark."

Here we find Frederik drawing on a shared reality of his and Victoria with respect to the market prices for electricity to argue for a specific interpretation. He construed a GCE as having entered a number wrongly, with the digits right but the position of the mark wrong. We may reconstruct this instance as Frederik not assuming that the local environmental manager thought wrongly, but that the correct thought has been wrongly entered. The idea of the digits being actually correct was based on Frederik's knowledge of market prices that did fit to the information entered by the Belgian agent.
With respect to the overall picture of carbon emissions, I should emphasise that mostly numbers have not been questioned. The cases above were exceptions. Because they were exceptions, they received considerably more attention than numbers that were perceived as adequate.
The practices of entering numbers in the database, of reviewing them and allowing agents to mend numbers constituted the maintaining of the carbon memory. The review of numbers by HQ agents can be understood as a flexible mechanism decoding the carbon image as would-be representations of reality and by that checking whether the carbon memory was adequately intact. Even though the criteria for adequateness were far less formalised that the video codecs described by Mackenzie[33] it is still obvious, that a checking against norms of prescriptive images took place. Frederik and Victoria were temporally enacting a community of interpretation[34] to judge the meaning of memories. Together, agents performed carbon emissions. Carbon emissions were not constructed once and for all, but, rather, they were to be retrieved from the carbon memory and communicated to others. Thus, like MacKenzie[35] or Beunza and Stark[36] described for economic actors, the amount of carbon emissions came into existence through a socio-technical network. What I tried to show with the examples above was that corporate carbon intelligence was only possible based on a cultural setting[37] that configured humans and non-humans in a specific way. Without relations between these actants, corporate carbon emissions could not have been enacted.

Now, let me point to another quality: the heterogeneity of intelligences that were part of the network. To keep the carbon memory efficiently in shape, HQ actors tried to lead local agents such that numbers were put into the database not only in the right way but also only if necessary. Here is a case in which Elise, the assistant of Frederik, voiced not being comfortable with the fact that a GCE, the Belgian, wanted more specific carbon factors for an indicator. How did that matter? In at least two ways. First, carbon factors are the key to translating an amount reported for any environmental indicator, say some average electricity mix, into carbon emissions. To illustrate, if a GCE used 5,000 giga joule of electrical energy, a carbon factor of 0.2 differs a great deal from 0.21. A carbon factor of 0.2 refers to 200 grams of CO2e per each MJ, resulting in this case at 1,000,000 kg of carbon emissions; a factor of 0.21 would result in 1,050,000 kg, the difference being 50

tons of carbon emissions. This is just one of many examples of what ESDR calculated as a substitute for human calculations. Here it is: seemingly automated computation. However, for the miracle of automated carbon foot-printing to take place, humans are necessary. They are the ones programming the algorithms, entering conversion factors, or not entering factors. Seemingly, then, humans were the ones who determined the generation of meanings and interpretations within the database.
Nevertheless, the community of interpretation was not restricted to humans. ESDR participated in interpreting the input by users and decided whether data was acceptable in a fundamental way: in several fields, the database only accepted numbers. Albeit some might argue that ESDR was merely acting according to the script it was given by the EMS-Team, this was not actually the case. GFQ once commissioned a company to programme the database. After the company had completed development of the product, the relationship between both firms were put on hold and another firm took over in the role of maintaining the ESDR source code. Yet, this firm's software engineer never achieved a full understanding of all the mechanisms within the database. It was too complex. Hence, the database was acting on its own – and not always in terms of the prescriptions of the environmental managers. This became present when Frederik once recognised that some of the number fields in the data entry forms allowed for negative values whereas only positive values were rational from Frederik's perspective. In this case, ESDR interpreted data according to different criteria than the humans involved. Thus, we find that carbon computation was co-constituted by humans and the database.
Second, the database's performance was technically constrained. Members perceived it as not running very fast. It was in that respect that, for Elise, it was straightforward to not have unnecessary complexity added to the database. At the same time, the following observation illustrates how carbon accounting was not only about numbers and limiting the load of computing but also about the power of forming the memory.

Field Note Extract 2.c (They should do it the right way)
Elise told me about the difficulties with Belgium regarding the conversion factors. She explained: This is how one has to do it – such that they do it the way I want it to be. Elise pointed out that it turns out to be more work for her when the Belgians use more exact conversion factors. At the same time, the sum would not change. I replied: Didn't we want more exact conversion factors? Elise: Yes, but it is of no use. She then explained that one has to bring the others to recognise that her proposal is better for her and constitutes less work for the Belgians. Elise told me that Dieter Klar is good at this. She continued to explain: "This is the way one has to do it", i.e. in the way that people are convinced that they have less work. The aim is "that they do it the way I want it to be done".

What seemed to be at stake here for Elise was her and Dieter being in control over local managers. Dieter was another assistant of Victoria.[38] To keep control of local managers this network deployed the social intelligence of Dieter to persuade local agents to work in the way the EMS-Team wanted. Thus, this was his official task: to take care of the network of environmental managers. My task was to take care of the technical side of the network, specifically of ESDR. The socio-technical network of which Frederik and Victoria were part was, hence, supported by two actors paid to keep the corporate carbon cognition system in function. Within this network some three assistants were necessary to sustain the network as it were in order to prevent the network from the theoretical total collapse that would happen when the data delivering people and their carbon communication tools would be amiss.[39] Persuasion and repair was necessary to prevent actants from dissenting.[40] While these considerations could be read as arguing for less human involvement in carbon administration, this would be misleading. The point is this: whether or not humans are at the surface part of this network, carbon computation ultimately is always also a human project, scoped, circumscribed and performed involving humans. Furthermore, reconfigurations of carbon administration that hide human involvement would distance affected publics from environmental politics even more. Instead, the role and agency of

humans in computing carbon emissions should be accounted for.

3 Carbon Accounting as a Machine

This section turns to a discussion of the carbon accounting system at a more abstract level, borrowing the term "machine" from Guattari.[41] For him, machines are characterised by their diagrammatic state. Machines have an unbodily abstract existence which "distinguishe[s them] from simple material agglomerates" "A heap of stones is not a machine, whereas a wall is already a static proto-machine, manifesting virtual polarities, an inside and outside, an above and below, a right and left…"[42] Does carbon accounting merely point to heaps of carbon emissions? I return to this question at the end of this section. To show how carbon accounting is more than the physical arrangement of computing elements but also involves the beliefs of actors and their politics beyond the socio-technical network, I turn to partial collapses of the machine. This move also allows us to sense the wider societal implications of the carbon machine.

Guattari proposed that the machine is characterised by breakdown[43] In this section I use this kind of moment associated with machines to elaborate the machinic character of carbon.

During an early stage of the cycle of carbon emission enactment, Elise was reviewing the reported data from the Indonesian GCE. When I talked with her on the phone, she explained why she was upset about the water data from Indonesia:

Field Note Extract 3.a (Facebook Transfer of Data)
"Alas! Guys." She told me that she is "negotiating via Facebook". She enquired whether they would not have a water meter. Yet, she learned: water is part of the lease.

This field note extract points to two forms of breakdown that the carbon accounting system experienced. First form of breakdown: Elise was using the internet-based social networking platform Facebook to communicate with a local agent who she otherwise experienced communication problems with. The EMS, of course, possessed officially prescribed ways of communication: who would be allowed to talk to whom. Practically, however, it often made no sense for members to follow these prescriptions. Where prescribed paths or forms of communication were not practical to put to use (because socio-organisational or material-virtual technologies were causing too much friction), members improvised: using the phone or, in this case, Facebook to communicate.

Second form of breakdown: the data-related problem she encountered was based on diverging contractual relations, for which the carbon accounting system, and – especially – ESDR, had not been designed. The system of cognition was based on data input. If data was not available for being directly read from an external source (like a water meter), local agents, analytically seen, had to decide whether to not report data for a respective indicator or whether to construct the data, i.e. "draw things together"[44] to form digestible data for the machine. This ethnographic finding turns the understanding by ecological modernists Burritt et al.[45] on its head. They claim to have found that carbon information is readily available to be collected by corporate agents of ecological modernisation. Recognising the lack of precisely such data as a breakdown, reveals the limited machinic character of carbon accounting. The carbon machine assumes this data to be present. And ecological modernist scholars may well be understood to be part of this machine: they reproduce its identity.

In the case above, the lease contract was including a lump-sum invoice for the offices rented by the GCE. The invoice did not differentiate costs caused by water consumption from other costs. This implied that the amount of water consumption was not communicated from the office provider to the Indonesian GCE. However, local agents were supposed to use invoices or meter readings to ground consumption amounts and then report these figures through ESDR. Here it is: a cause for breakdown that one could interpret as located outside of the formal boundaries of GFQ. GCEs did not have direct control over the forms of invoices readily available on local markets. The lump-sum

problem was frequently encountered by HQ actors, also e.g. in the USA and Malaysia. How does this matter to our understanding of carbon accounting as a machine? Guattari uses the concept of assemblage as including "possible fields, of virtual as much as constituted elements"[46]. I argue that what I found at GFQ can be understood as such an assemblage. The machinic assemblage with the function of providing an account of carbon emissions involved communication fields. While some communication relations were prescribed and often enacted, others remained virtual, not actualised, to speak with Sayer. [47] However, in moments of breakdown, such virtual elements could turn into actual reality. Facebook allowed for actual communication. However, the breakdown stemming from non-existing data was not that easy to overcome.
Because of this problem, as much as for a variety of other problems, GFQ decided to transform the carbon accounting system, exchanging key elements. A year after the fieldwork had been undertaken, four of five members of the EMS-Team had been exchanged and ESDR was to be substituted by a SAP based accounting database and corresponding workflow. Beunza and Stark provide a useful study of how workers may engage with a breakdown of their work infrastructure.[48] In the case of ecological modernisation, the substitution of machinic elements was enacted as a promise to achieve accounting of carbon emissions free of breakdown. Guattari proposes that in such machinic assemblages "form takes precedence over consistency and over material singularities"[49]. In the following, I will explore this understanding empirically.

While the transformation the EMS was targeted in avoiding breakdown, members involved in the machine's repair process voiced that breakdowns of the second form discussed above could be expected to continue turning into actual existences. However, it did not seem well advisable to voice such thoughts intensively. Rather, we may say, these considerations were not to enter GFQ's extended carbon mind. The machine did not provide fields for some of the machine-intrinsic critique. Eventually, such thought did not enter the corporate carbon mind. The implication of this is akin to the point made by Guattari referred to above: solving carbon problems requires societies to find new ways of living and configuring themselves, rather than reproducing the corporate machines. Empirically, the mentality to which the carbon accounting system of GFQ had been changed, alas, can be characterised through this observation of the environmental manager who took over the role from Frederik. I call this substitute agent Jack Newman. He suggested:

Field Note Extract 3.b (Pure Numbers, Stripped off of Comments)
The idea to get pure numbers with SAP system is great! Without comments!

While the older database type allowed users to enter comments about the numbers reported, the substitute element under the follow-up configuration of the machine was not designed to record such information. The vision by Jack was one of a much more focused mind, not getting confused and distracted with local complexities. Repairing informational machines and reducing the noise surrounding "informational components" is key for the machine's "functional identity" [50]. What I found here depicts the modern dream described by Max Weber when discussing calculability: According to Köhler's reading of Weber the modern bureaucratic project aimed at the "transformation of surprises and irregularities into an expectable", i.e. predictable, reality.[51]
What is the cost of forming this carbon machine? With Guattari[52] we might say: the forms of accountable carbon are limited. At the same time, carbon computing is mutant. It relates to Universes of reference beyond direct carbon emissions. The carbon machine reproduces the illusionary promises of greening capitalism by arrogating the straightforward representation of natural facts.

"Capital, Energy, Information, the Signifier are so many categories which would have us believe in the ontological homogeneity of referents (biological, ethological, economic,

phonological, scriptural, musical, etc.)."[53]

Computer carbon is merely another category presuming its homogenous and exterior-world referents. However, this discussion showed: carbon is no more natural and given than categories like sex or gender.[54] Nevertheless, carbon emission sums are enacted publicly. They turn into matter even though nobody was actually interested in discovering and scrutinising facts. Rather, carbon is performed as computed and, therefore, trustable.[55] This is the imaginary effect: GFQ has its emissions under control. A heap of carbon is as much a machine as a stone. Depending on the empirical situation, they may both perform insides and outsides. Do you believe in mountain tops marked by heaps of stones? Do carbon emissions demand a reaction by the polluter? Carbon emissions are the machinic effect of a heterogeneously configured administration machine. The machine produces a demanding machine, which, in effect, provides the power for computing more carbon.

4 Conclusion

This article used ethnographic data from a multinational company, GFQ, to investigate the computation of its carbon emissions. GFQ wanted to know its carbon emissions in order to position itself within the Universe of references to carbon, co-constituted e.g. by global investors and rankings. Corporate carbon accounting would not exist as such without exterior references to carbon [56]. All the players in this universe, NGOs, governments, companies perform carbon facts. They use extended systems to recognise carbon emissions of all kinds of entities, including but not limited to companies or nation-states. By visiting HQ based environmental managers and carbon accountants, this article provided insight into the heterogeneous, distributed and extended qualities of GFQ getting to know its carbon emissions. Several humans and non-humans, present as well as absent – including e.g. computers, distributed technical information systems, everyday knowledges, invoices and water meters – were part of this socio-technical network to provide emissions facts for the multinational's carbon memory. Furthermore, by attending to the machinic character of carbon, it became recognisable that the specific configuration of carbon administration is fluid while the machine's informational elements are contested and need to be continually enacted. The maintaining of socially and economically recognisable carbon emission facts adds another unidentifiable category to our world.

To conclude, I like to interpret the machine in its discursive environment. Under which conditions is such a machine functional? It is within a context of quantitative references that numerical carbon reporting is meaningful. Where nation-states and intergovernmental institutions think in terms of relative carbon emissions it is only straightforward for GFQ to quantify their emissions and report them as relative figures. Just like nation-states declared CO2 reduction aims, like minus 8 per cent, so does GFQ. Organisations like GFQ relate to this new field of reference, i.e. a Carbon Universe – if I may borrow this concept from Guattari, even if they are not legally required. Guattari[57] suggested that Universes can be incorporeal, like music or mathematics. I propose that Carbon has moved beyond a collective equipment [58]. Rather, Carbon constitutes now a highly heterogeneous socio-techno-natural field where multiple and contradictory references can be made to carbon. Moving outside of this space is not considered anymore. Carbon machines do not simply appear to be allopoietic, i.e. generate emission facts, but they are also autopoietic: the configuration of the machine, including technological, institutional and human elements, ensures that carbon machines reproduce themselves and each other.[59] Together they perform the Carbon Universe.

At the same time, this Universe is restricted to a narrow understanding of Carbon. Absolute numbers and long-term prospects of activities causing carbon emissions do not matter here. What the machines can perceive and communicate to external audiences are short-term prospects of carbon reductions. Whether an activity which saves carbon

emissions now is likely to sustain a high-carbon development trajectory does not matter, argues Lohmann.[60] Rather, meaning in this Universe is constituted through differentials, differences between the carbon efficiencies. However, like with problems with video codecs[61] it happens that seeing and dealing with differentials may not show enough to orientate ourselves. If we think of Carbon as a new kind of space, then, following Thrift,[62] the question emerges, whether people think and move differently. My analysis of the repair of the carbon accounting machinery suggests, unfortunately, that new kinds of movements could not be identified, rather reactionary ones. Thus, precisely because people and organisations figured themselves in terms of this new kind of quantity (carbon foot-printing everywhere!), with respect to their impacts on the environment, I could not identify a trajectory by members of emancipating themselves or imagined natures from computing quantifiable carbon within the multinational. The corporate reality I encountered indicated much rather an ecologically modernised (re)production of the Carbon Universe. The shift by GFQ from ESDR to SAP reflects the gist of the enactment of Carbon. The computation and qualculation of carbon was put on the agenda for improvement. This politics of shaping Carbon is mirrored by this take in accounting research: Zvezdov et al. call for decreasing the transaction costs of carbon accounting by "more efficient information distribution and less effort for providers of information".[63] Thus, corporation and researchers contribute to stabilise the same machinery. The production of carbon information is to not disturb the smooth running of corporation's actual purposes – making profits.

How to enact another politics? If I imagine myself to be a carbon equivalent entity, I would at least want the accountants to provide an account of how they imagined me and what they silenced. Computing primarily quantified carbon glosses over the actual and practical realities through which the emissions are translated into social and economic reality. For an emancipatory political philosophy of Carbon I propose this:[64] climate action needs to be grounded in detailed stories of carbon entities and the machines in which these entities are generated. Situated accountability[65] calls for learning to enact publicly accounts of environmental realities as partial judgements; making explicit the qualculative quality of the hegemonic understanding and machinic co-enactment of carbon, and forcing societal decisions to engage with this quality, might be fruitful to reconfigure the Carbon Universe. Corporations should not be allowed to reduce Carbon to a matter of number handling. A better way of living would entail the control over emissions (and offsets thereof) by all affected stakeholders at each of the globally distributed production as well as consumption sites.

Such alternative needs to be grounded in an alternative carbon cognition machine. Quantitatively oriented material inscription devices need to discarded and give way for technologies which position users to render their judgements as well as the choices taken by the new machinery itself explicit. Carbon qualculations would then be differently, and normatively better, intelligible. Global emissions are locally caused and enacted. An emancipatory engagement with Carbon needs to reconfigure these situated and heterogeneously mediated practices.

References

Asdal, K. (2008). Enacting things through numbers: Taking nature into account/ing. *Geoforum* 39 (1), 123-132.

Beunza, D. and D. Stark (2003). The organization of responsiveness: innovation and recovery in the trading rooms of Lower Manhattan. *Socio-economic Review* 1 (2), 135.

Böhm, S. and S. Dabhi (Eds.) (2009). *Upsetting the Offset: The Political Economy of Carbon Markets*. London: MayFly.

Bowker, G. C. and S. L. Star (2000). *Sorting things out: classification and consequences*. Cambridge Massachusetts: MIT Press.

Burritt, R., S. Schaltegger, and D. Zvezdov (2011). Carbon management accounting: Explaining practice in leading German companies. *Australian Accounting Review* 21 (1), 80-98.

Butler, J. (1993). *Bodies that matter: on the discursive limits of 'sex'.* New York: Routledge.

Buttel, F. (2000). Ecological modernization as social theory. *Geoforum* 31, 57-65.

Callon, M. (1999). Some elements of a sociology of translation: Domestication of the scallops and the fishermen of saint brieuc bay. In M. Biagioli (Ed.), *The Science Studies Reader*, pp. 67-83. New York, London: Routledge.

Callon, M. and J. Law (2005, Jan). On qualculation, agency, and otherness. *Environment and Planning D* 23 (5), 717-733.

Clark, A. (2010). Memento's revenge: Objections and replies to the extended mind. In R. Menary (Ed.), *The Extended Mind*, Chapter 3, pp. 43-66. Cambridge (Massachusetts), London: MIT Press.

Dingler, J. (2003). Postmoderne und Nachhaltigkeit. Eine diskurstheoretische Analyse der sozialen Konstruktion von nachhaltiger Entwicklung, Volume 7 of *Hochschulschriften zur Nachhaltigkeit*. München: ökom.

Guattari, F. (1995). *Chaosmosis an ethico-aesthetic paradigm.* Bloomington and Indianapolis: Indiana University Press.

Haraway, D. (1991). Situated knowledges: the science question in feminism and the privilege of partial perspective. In *Simians, Cyborgs, and Women*, Chapter 9, pp. 193-201. London: Free Association Books.

Huber, J. (1988). *Die Regenbogen-Gesellschaft*. Frankfurt am Main: Fischer-Taschenbuch-Verlag.

Hutchins, E. (2008). The role of cultural practices in the emergence of modern human intelligence. *Philosophical Transactions of the Royal Society* 363, 2011-2019.

Jackson, S., P. Edwards, G. Bowker, and C. Knobel (2007). Understanding infrastructure: history, heuristics, and cyberinfrastructure policy. *First Monday* 12 (6).

Köhler, B. (2010). Macht der Zahlen, Herrschaft der Statistik – Eine machttheoretische Skizze. In C. Lau and W. Bonß (Eds.), *Macht und Herrschaft in der reflexiven Moderne*. Weilerswist: Velbrück.

Latour, B. (1987). *Science in Action: How to Follow Scientists and Engineers Through Society*. Cambridge, Massachusetts: Harvard University Press.

Latour, B. (1990). Drawing things together. In M. Lynch and S. Woolgar (Eds.), *Representation in Scientific Practice*, pp. 19-68. Cambridge (Massachusetts), London: MIT Press.

Law, J. (1992). *Notes on the Theory of the Actor Network: Ordering, Strategy and Heterogeneity.* http://www.lancaster.ac.uk/fss/sociology/papers/law-notes-on-ant.pdf: online retrieved 2006, Nov. 02.

Law, J. (1997). *The Manager and His Powers*. Lancaster University, Department of Sociology.

Lippert, I. (2010a). *Agents of Ecological Modernisation.* Tönning, Lübeck, Marburg: Der Andere Verlag.

Lippert, I. (2010b). Disposed to unsustainability? Ecological modernisation as a techno-science enterprise with conflicting normative orientations. In A. Bammé, G. Getzinger, and B. Wieser (Eds.), *Yearbook 2009 of the Institute for Advanced Studies on Science, Technology and Society*, pp. 275-290. München: Profil.

Lippert, I. (2010c). Voluntary standards. In N. Cohen and D. P. Philipsen (Eds.), *Green Business: An A-to-Z Guide*, The SAGE Reference Series on Green Society: Toward a Sustainable Future-Series. Sage Publications.

Lippert, I. (2011). Limits to managing the environment. In M. Schmidt, V. Onyango, and D. Palekhov (Eds.), *Implementing Environmental and Resource Management*, Part III, pp. 209. Heidelberg: Springer.

Lohmann, L. (2009). 2: *Neoliberalism and the calculable world: The rise of carbon trading*. See Böhm and Dabhi (2009), pp. 25-37.

Mackenzie, A. (2008). *Every thing thinks: sub-representative differences in digital video codecs*. Downloaded 23/8/2011 from http://www.lancs.ac.uk/staff/mackenza/papers /mackenzie_everything_things_codecs_may08.pdf.

MacKenzie, D. (2009a, Apr). Making things the same: Gases, emission rights and the politics of carbon markets. *Accounting, Organizations and Society* 34 (3-4), 440-455.

MacKenzie, D. (2009b). *Material Markets: How Economic Agents are Constructed.* Oxford University Press.

Mol, A. (2002). *The Body Multiple: Ontology in Medical Practice.* Durham, N. Ca., and London: Duke University Press.

Porter, T. (1995). *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life*. Princeton, New Jersey: Princeton University Press.

Power, M. (1999). *The audit society: rituals of verification.* Oxford: Oxford University Press.

Sayer, A. (2000). *Realism and Social Science.* London, Thousand Oaks, New Dehli: Sage Publications.

Shackley, S. and B. Wynne (1995, August). Mutual construction: Global climate change: the mutual construction of an emergent science-policy domain. *Science and Public Policy* 22 (4), 218-230.

Strathern, M. (2004). *Partial connections.* Walnut Creek: Altamira Press.

Szerszynski, B. and J. Urry (2010, Mar). Changing climates: Introduction. *Theory, Culture & Society* 27 (2-3), 1-8.

Thrift, N. (2004). Movement-space: The changing domain of thinking resulting from the development of new kinds of spatial awareness. *Economy and Society* 33 (4), 582-604.

Verran, H. (1999). Staying true to the laughter in Nigerian Classrooms. In J. Law and J. Hassard (Eds.), *Actor Network Theory and After*, The Sociological Review, pp. 136-155. Oxford, Malden: Blackwell.

Zvezdov, D., S. Schaltegger, and M. Bennett (2010, Dec). The increasing involvement of accountants in corporate sustainability management. *Journal of the Asia-Pacific Centre for Environmental Accountability* 16 (4), 20-31.

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1. Note, in this paper I use the signs "carbon", "carbon dioxide" and "CO2 " and "greenhouse gas" interchangeably. Technically, I am speaking of "CO2 e", i.e. "equivalent CO2 ", if I do not explicitly state otherwise. Cf. MacKenzie (2009a) for a more detailed discussion of conversion factors between these gases and their politics. (up)
2. Lippert, I. (2011). Limits to managing the environment. In M. Schmidt, V. Onyango, and D. Palekhov (Eds.), *Implementing Environmental and Resource Management*, Part III, pp. 209. Heidelberg: Springer. (up)
3. See, Zvezdov, Schaltegger, and Bennett 2010; Burritt, Schaltegger, and Zvezdov 2011 (up)
4. Latour, B. (1987). *Science in Action: How to Follow Scientists and Engineers Through Society*. Cambridge, Massachusetts: Harvard University Press. (up)
5. Dingler, J. (2003). *Postmoderne und Nachhaltigkeit. Eine diskurstheoretische Analyse der sozialen Konstruktion von nachhaltiger Entwicklung*, Volume 7 of Hochschulschriften zur Nachhaltigkeit. München: ökom. (up)
6. Huber, J. (1988). Die Regenbogen-Gesellschaft. Frankfurt am Main: Fischer-Taschenbuch-Verlag. (up)
7. Buttel, F. (2000). Ecological modernization as social theory. Geoforum 31, 57-65. (up)
8. An EMS promises its implementing organisation to achieve its greening aims step by step. This organisational form can be considered archetypical for ecological modernisation. The idea is quite simple: the corporation knows best its environmental relations and impacts. Correspondingly, it should set itself goals, identify its environmental status and implement measures to reach its goals. Subsequently, the situation can be reassessed and goals or measures adapted. It constitutes a typical procedural management tool (a significant voluntary standard is e.g. as ISO 14.001 (Lippert 2010c)). External control by society or authorities is deemed unsuitable beyond inviting auditors (cf. Power 1999). (up)
9. Guattari, F. (1995). Chaosmosis an ethico-aesthetic paradigm. Bloomington and Indianapolis: Indiana University Press.p31 (up)
10. Guattari, Ibid., p.20 (up)
11. Szerszynski, B. and J. Urry (2010, Mar). Changing climates: Introduction. *Theory, Culture & Society* 27 (2-3), 1-8., p.4 (up)
12. Asdal, K. (2008). Enacting things through numbers: Taking nature into account/ing. *Geoforum* 39 (1), 123-132. (up)
13. Shackley, S. and B. Wynne (1995, August). Mutual construction: Global climate change: the mutual construction of an emergent science-policy domain. *Science and Public Policy* 22 (4), 218-230. (up)
14. See, i.e. MacKenzie 2009a; Böhm and Dabhi 2009 (up)
15. See, i.e. Lohmann 2009; MacKenzie 2009b. (up)

16. Sayer, A. (2000). *Realism and Social Science*. London, Thousand Oaks, New Dehli: Sage Publications. (up)
17. See Latour op cit. (up)
18. Law, J. (1992). Notes on the Theory of the Actor Network: Ordering, Strategy and Heterogeneity. http://www.lancaster.ac.uk/fss/sociology/papers/law-notes-on-ant.pdf: online retrieved 2006, Nov. 02. (up)
19. Mol, A. (2002). The Body Multiple: Ontology in Medical Practice. Durham, N. Ca., and London: Duke University Press. (up)
20. Within and beyond STS, the work by Latour (1987) is called Actor-network theory (ANT) and the recent work by Law (1992) and Mol (2002) "ANT and after". (up)
21. The notion of agents of ecological modernisation refers to those who are supposed or assumed to put into practice the politics of ecological modernisation.[22. See, Lippert 2010a; Lippert 2010b. A book is planned to provide a detailed report about the results of this study. A focused ethnographic description of some of the underlying classification practices within carbon accounting can be found in Lippert (forthcoming). (up)
22. Strathern, M. (2004). Partial connections. Walnut Creek: Altamira Press. (up)
23. Haraway, D. (1991). Situated knowledges: the science question in feminism and the privilege of partial perspective. In, *Simians, Cyborgs, and Women*, Chapter 9, pp. 193-201. London: Free Association Books. (up)
24. Participant observation took place over a period of 13 months while research subjects were aware of my role as researcher studying the culture, interaction and achievement of their every day work. (up)
25. The group's name as well as all data revealing its identity, as well as all the names of members central to the study have been anonymised. Further, I converted currency data into USD and EUR; and I provide other units in SI metrics. (up)
26. The period of my empirical work paralleled the development of the global financial crisis of 2008 to 2010. (up)
27. Guattari op cit. (up)
28. By this, this paper may also be read as corresponding with recent debates in STS, Critical Management Studies as well as the emerging critical studies of environmental management and ecological modernisation as situated practice. (up)
29. Callon, M. and J. Law (2005, Jan). On qualculation, agency, and otherness. Environment and Planning D 23 (5), 717-733. (up)
30. Verran, H. (1999). Staying true to the laughter in nigerian classrooms. In J. Law and J. Hassard (Eds.), Actor Network Theory and after, The Sociological Review, pp. 136-155. Oxford, Malden: Blackwell. (up)
31. Verran, ibid, p150 (up)
32. Clark, A. (2010). Memento's revenge: Objections and replies to the extended mind. In R. Menary (Ed.), The Extended Mind, Chapter 3, pp. 43-66. Cambridge (Massachusetts), London: MIT Press. (up)
33. Mackenzie, A. (2008). *Every thing thinks: sub-representative differences in digital video codecs*. Downloaded 23/8/2011 from http://www.lancs.ac.uk/staff/mackenza/papers/mackenzie_everything_things_codecs_may08.pdf/ (up)
34. Beunza, D. and D. Stark (2003). The organization of responsiveness: innovation and recovery in the trading rooms of Lower Manhattan. Socio-economic Review 1 (2), 135. (up)
35. MacKenzie, D. (2009b). *Material Markets: How Economic Agents are Constructed*. Oxford University Press. (up)
36. op cit (up)
37. Hutchins, E. (2008). The role of cultural practices in the emergence of modern human intelligence. Philosophical Transactions of the Royal Society 363, 2011-2019. (up)
38. We have now encountered all five members of the EMS-Team, the bosses, Victoria and Frederik, and their three assistants, Dieter, Elise and myself. (up)

39. Law (1997) describes such a dismantling of a network. (up)
40. Callon, M. (1999). Some elements of a sociology of translation: Domestication of the scallops and the fishermen of saint brieuc bay. In M. Biagioli (Ed.), *The Science Studies Reader*, pp. 67-83. New York, London: Routledge. (up)
41. Guattari, op cit, Chapter 2) (up)
42. Guattari, Ibid p.42 (up)
43. Guattari, Ibid p.35, and p/41. Failure would also be considered with Bowker and Star (2000) or Jackson, Edwards, Bowker, and Knobel (2007) as an apt entry point to study how carbon appears as a distributed machine, as infrastructure. (up)
44. Latour, B. (1990). Drawing things together. In M. Lynch and S. Woolgar (Eds.), *Representation in scientific practice*, pp. 19-68. Cambridge (Massachusetts), London: MIT Press. (up)
45. Burritt, R., S. Schaltegger, and D. Zvezdov (2011). Carbon management accounting: Explaining practice in leading German companies. *Australian Accounting Review* 21 (1), 80-98. (up)
46. Guattari, op cit, p.35 (up)
47. Sayer, A. (2000). *Realism and Social Science*. London, Thousand Oaks, New Dehli: Sage Publications. (up)
48. Beunza and Stark, op cit., 144-145. They describe how workers, whose office had been physically damaged and their infrastructure rendered unusable to a large degree, used actually existing elements to substitute the broken down elements of the machinery they were part of. Their cases involve offices affected by the World Trade Centre destruction in 2001. Office workers were continuing to work in a substitute office, bringing for example IT infrastructure elements from home or using knowledges which had not been formally necessary to engage with their work, but were available. Workers used information about the loved ones of killed workers who possessed corporate passwords to hack into their corporations' databases.(up)
49. Guattari, op cit, p.44. (up)
50. ibid, p.41 (up)
51. Köhler, B. (2010). Macht der Zahlen, Herrschaft der Statistik – Eine machttheoretische Skizze. In C. Lau and W. Bonß (Eds.), Macht und Herrschaft in der reflexiven Moderne. Weilerswist: Velbrück. (up)
52. op cit, 36 (up)
53. Ibid, 46 (up)
54. Butler, J. (1993). Bodies that matter: on the discursive limits of 'sex'. New York: Routledge. (up)
55. For the notion of trusting numbers, see the work by Porter (1995). (up)
56. cf. Guattari, op cit, 37 (up)
57. Guattari, op cit, 16 (up)
58. ibid., 10 (up)
59. cf. ibid., 40 (up)
60. Lohmann, L. (2009). 2: Neoliberalism and the calculable world: The rise of carbon trading. See Böhm and Dabhi (2009), pp. 25-37. see esp. p.28 (up)
61. Mackenzie, Everything Thinks, op cit. (up)
62. Thrift, N. (2004). Movement-space: The changing domain of thinking resulting from the development of new kinds of spatial awareness. Economy and Society 33 (4), 582-604. (up)
63. Zvezdov, D., S. Schaltegger, and M. Bennett (2010, Dec). The increasing involvement of accountants in corporate sustainability management. Journal of the Asia-Pacific Centre for Environmental Accountability 16 (4), 20-31. see esp. p.28 (up)
64. The status of this proposition can be described as a normative outlook; this article does not provide the space to develop a coherent emancipatory political philosophy. (up)
65. Haraway, D. (1991). Situated knowledges: the science question in feminism and the

privilege of partial perspective. In *Simians, Cyborgs, and Women*, Chapter 9, pp. 193-201. London: Free Association Books. (up)

Revision History

Revision date 29/03/2013: Two sentences moved from Footnote 48 into main body.
